ference of polarised light follows a normal path, but the part relating to biaxial crystals is unusually full. The later chapters deal with absorbing media, dispersion, structurally active media, and magnetically active media; each of these phenomena is shown to follow from suitable modifications in the expression for the light vector; the interesting question of the constitution of the ether which could give rise to such modifications is, of course, in the author's scheme passed by. But while this is necessarily the case, the analysis given is very full and complete, and Mr. Walker has added to the literature of the subject a book of real value. The book has been printed at the Cambridge Press and published by the Syndics, and their share of the work is admirable.

LIQUID CRYSTALS.

Kristallinische Flussigkeiten und flussige Kristalle. By Rudolf Schenck. Pp. viii+158. (Leipzig: Wilhelm Engelmann, 1905.)

THE announcement of the discovery of liquids that were doubly refracting and dichroic by Prof. Lehmann some fifteen years ago was received with considerable mistrust, for the possession by a liquid of these properties which had hitherto been associated solely with the solid crystalline state seemed at first sight almost inconceivable, and quite inconsistent with the generally accepted ideas as to the molecular tactics of liquids and crystals. The very name of liquid crystal seemed to be self-contradictory. Lehmann's results, however, were soon confirmed by other physicists, one of the most active amongst whom was Dr. Schenck, the writer of the present work on the subject.

Several explanations of Lehmann's observations were offered, based on the assumption that he had worked with liquids containing impurities. Quincke supposed them to consist of solid crystalline particles surrounded by a film of liquid, and Tammann endeavoured to explain their properties by assuming them to be an emulsion of two liquid phases. On the other hand, Lehmann pointed out that it was not justifiable to consider these cases as if they were isolated instances of irregular properties, since the behaviour of these liquids apparently so anomalous may be reconciled with that of other crystalline media if we consider the part played by the rigidity of crystals in maintaining their crystalline form. His investigations have shown that the rigidity of different crystals varies within wide limits. The majority of those we know best offer considerable resistance to deformation, while some, like yellow phosphorus, are quite soft, and others, such as the oleates, have so little rigidity that the force of surface tension is sufficient to deform the crystal from its true geometrical shape; in the limiting case, that of *p*-azoxyanisol and the other liquids investigated by Lehmann, the rigidity has become so small compared with the force due to surface tension that the crystal when placed in a liquid of equal density assumes a spherical form.

Lehmann's work was entirely microscopic, but macroscopic investigations were undertaken by other investigators. A study of the physical properties of the birefringent liquids, particularly of their viscosity and dielectric constants, and an unsuccessful attempt to resolve them by cataphoresis, showed that each of them was without doubt a single substance, and thus the hypotheses put forward by Quincke, Tammann, and other authors were disproved.

Prof. Lehmann's monograph on these bodies, which was reviewed in NATURE recently (vol. lxx., p. 622, 1904), consists mainly of an account of the results of his microscopic investigations and of the theory he has formulated to explain these. A very important part of the work was thus left undescribed, and Dr. Schenck's book covers the ground omitted by Lehmann, and, in addition, gives a short summary of the latter's experiments.

The preparation of the various substances that have been found to yield anisotropic liquids is described in detail, also the determination of their physical constants. The investigation of the surface energy of the liquids indicates that there is no sudden change in their molecular weight at the temperature at which the anisotropic liquid passes into the isotropic condition. The viscosity curves, however, show a large break at this temperature, the isotropic liquids being in some cases the more viscous. The density curves show a similar discontinuity. The two liquids have different specific heats, and there is a small but definite heat of transformation of one form to the other.

Dr. Schenck has given a very complete account of our knowledge of these anomalous liquids, which have great interest both for the chemist and physicist, and his book will be of great service to those who wish for information about them. It is clearly written and arranged, and contains a number of diagrams and plates. Of theories as to their nature he wisely fights very shy, and it seems that considerably more work is needed before we shall be able to form any clear idea as to their molecular structure.

H. B. H.

PLANT-BREEDING IN AMERICA.

New Creations in Plant Life: an Authoritative Account of the Life and Work of Luther Burbank. By W. S. Harwood. Pp. xiv+368; 50 illustrations. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) Price 7*s.* 6*d.* net.

THERE is something to be said in favour of this work; at the same time we imagine no one will have more cause to regret its appearance than Mr. Burbank himself. The reasons for this expression of opinion are easily supplied. It is decidedly desirable that the outside public should be made aware of the enormous practical importance of what is called plant-breeding, and that they should be familiarised with the means and methods adopted by experts for the multiplication and improvement of flowers, fruits, and other vegetable products. A slightly increased percentage of sugar in the sugar-cane or the beet, an apparently trifling improvement in the staple of

cotton, the development of a potato relatively immune to fungous diseases, an increased production of fruit or the introduction of hardier varieties, of some that are earlier, of others that are later, to say nothing of the improvement of flowers in form, colour, and perfume, are all points of great importance and of very great interest from a biological point of view.

In this field of work Mr. Burbank has long been known as an energetic labourer, and it is quite possible that in actual amount his work bulks larger than that of any of his predecessors or his contemporaries. Moreover, as we learn from the book before us, and from other sources, the experimenter is a man of high purpose, modest, and amiable. It is for these personal reasons we imagine that he will have cause to regret the appearance of this volume. We have no desire to belittle Mr. Burbank or to undervalue the importance of what he has accomplished. We believe that he would be the first to acknowledge that there existed strong men previous to the appearance of Agamemnon. But this is a fact that his eulogist does not sufficiently estimate. In perusing the glowing paragraphs of this volume the casual reader might imagine that there were no plant-breeders before Burbank, or that their labours were comparatively insignificant, and yet in our own country alone we seem to have heard of Thomas Andrew Knight, of Dean Herbert, of Trevor Clarke. of Thomas Rivers, of John Laing, of Dominy, of Seden, of Laxton, and of a large number of others whose productions at least vie in importance with those of the American experimenter, whilst a visit to the great establishments of Vilmorin, near Paris, Benary, and others at Erfurt and Quedlinburg, as well as to the trial-grounds of our Veitchs, Suttons, Carters, and many others, would show that the great American hybridist is by no means without a rival in his line of work.

It would hardly be fair to criticise those products of Mr. Burbank's skill and perseverance that have reached us, because it may well be that they are not yet adapted to our climate. At any rate, to name only a few instances, the Burbank plum, the Burbank lily, the Shasta daisy, all so enthusiastically spoken of in the pages of this book and elsewhere, have not, in this country, justified the encomiums passed upon them by the American Press.

When we read of Mr. Burbank's methods of work we do not find anything different from the practices of our "raisers," who are too modest to speak of their efforts as "creations."

Among the "creations" mentioned in this volume is the "thornless edible cactus." Surely we have heard of and seen a spineless Opuntia before attention was called to it in this volume, where it is stated that "nothing more marvellous has ever been done in plant-life"!

Again, "the rare effects developed in the transformation of the columbine" do not differ (so far as we can tell from the illustration facing p. 359) from the stellate columbine known in our gardens for centuries and figured on p. 273 of Parkinson's Paradisus (1629).

A man who has experimented on such a colossal scale for so long a time might be expected to have gathered valuable information on such points as heredity, adaptation, inheritance of acquired characters, as well as formed opinions on Mendelism and mutation. We gather from the book before us that Mr. Burbank's attention has, almost of necessity, been directed to these subjects, and we earnestly hope that now that the Carnegie Institution has granted him a subvention of ten thousand dollars a year for ten years he will find time to record and coordinate his experiments for the benefit of future workers and the increase of biological knowledge.

Incidentally, we glean that Mr. Burbank is not inclined to accept the views of Weismann or of Mendel, but that he looks favourably on the mutation theory of De Vries. Surely no practitioner has had better opportunities of judging of these matters than has Mr. Burbank, and if he will give us his own experiences in his own words, rather than in those of some too partial biographer, the world will be the gainer, and the value of Mr. Burbank's work more accurately gauged than it can be from the perusal of the present volume.

CHEMICAL TECHNOLOGY.

Chemische Technologie. By Dr. Fr. Heusler. Pp. xvi+350. (Leipzig: B. G. Teubner, 1905.) Price 8 marks.

THE author states in the preface that the work is intended for the use of merchants. This at once opens up the question whether a book of this kind, ostensibly written for non-chemists, can fulfil its object. The author is under the impression that a merchant has acquired, in the course of his secondary education, sufficient knowledge to read and interpret chemical equations, and he adopts in his work chemical symbols throughout, in the belief that it would be almost an insult to the German merchant to think him incapable of understanding chemical equations.

The reviewer cannot agree with this opinion in its broad generality. His own experience would lead him to confirm in this respect the truth of the trite old saying, "A little knowledge is a dangerous knowledge." When the commercial director of a chemical works asks his chemist, in times of stress, to use a sulphuric acid of 50° Bé instead of 66° Bé on the score that the former is so much cheaper for the same amount of sulphuric acid, or when the chief clerk struts through the works meddling with the chemistry of the business, then the chemist would certainly prefer the English system of subdividing the work. Of course, there are merchants who are fully able to understand purely chemical questions, but such merchants would certainly have recourse to the extensive manuals on their own specialities rather than study the present work, in which the information on every subject must necessarily be very meagre.

From this point of view the book is not within the horizon of the average chemical merchant. The tendency to explain the subject so far as possible by equations necessarily leads to a twisted and sometimes wrong representation, as these may be read to